Application No. 10/581,074

Reply to Office Action of October 23, 2007

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Currently Amended): A process for variably preparing mixtures of optionally alkyl-substituted butanediol (BDO), butyrolacetone (GBL) and tetrahydrofuran (THF) by two-stage hydrogenation in the gas phase of C₄ dicarboxylic acids and/or derivatives thereof, which comprises

- a) hydrogenating in a gas phase a gas stream of C₄ dicarboxylic acids and/or derivatives thereof over a catalyst at a pressure of from 2 to 100 bar and a temperature of from 200°C to 300°C in a first reactor in the presence of a <u>noble metal-free</u> catalyst in the form of shaped catalyst bodies having a volume of less than 20 mm³, said catalyst from 5 to 95% by weight of oxide of copper and from 5 to 95% by weight of an oxide having acidic sites, to give a stream containing alkyl-substituted GBL and THF,
 - b) removing any succinic anhydride (SA) formed by partial condensation,
- c) converting the products remaining predominantly in the gas phase in the partial condensation, THF, water and GBL, under the same pressure or under a pressure reduced by the pressure drops in the hydrogenation circuit and at a temperature of from 150 to 240°C, in a second reactor over a noble metal-free catalyst which \leq 95% by weight of CuO and from 5 to 95% by weight of one or more oxides selected from the group of ZnO, Al₂O₃, SiO₂, TiO₂, ZrO₂, CeO₂, MgO, CaO, SrO, BaO, La₂O₃ and Mn₂O₃ to give a stream comprising a mixture of BDO, GBL and THF,
 - d) removing the hydrogen from the products and recycling it into the hydrogenation,
- e) separating by distillation the products, THF, BDO, GBL and water, recycling a GBL-rich stream into the second reactor or discharging it, and working up BDO, THF and GBL by distillation,

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and setting the ratio of the products, THF, GBL and BDO, relative to one another within the range from 10 to 100% by weight of THF, from 0 to 90% by weight of GBL and from 0 to 90% by weight of BDO only by varying the temperatures in the two hydrogenation zones reactors and also the GBL recycle stream.

Claim 2 (Previously Presented): The process according to claim 1, wherein the partial condensation of the succinic anhydride is designed as a circulation quench cycle.

Claim 3 (Previously Presented): The process according to claim 1, wherein the evaporation of the recycled GBL or GBL/water mixture is effected in a countercurrent apparatus, with the GBL/THF-laden cycle gas hydrogen.

Claim 4 (Previously Presented): The process according to claim 1, wherein the partial condensation of the succinic anhydride and the evaporation of the GBL or GBL/water recycle stream are combined in one apparatus, and the succinic anhydride is discharged as the bottom effluent together with residual GBL, water and high-boiling secondary components.

Claim 5 (Previously Presented): The process according to claim 1, which is carried out continuously.

Claim 6 (Previously Presented): The process according to claim 1, wherein the inlet temperature in the first reactor is at values of from 200°C to 300°C, and from approx. 5 to 15°C, below the hotspot temperature.

Claim 7 (Previously Presented): The process according to claim 1, wherein the temperature increase in the second reactor is not more than 90°C.

Claim 8 (Previously Presented): The process according to claim 1, wherein the inlet temperature in the second reactor is at values between 150°C and 270°C.

Claim 9 (Previously Presented): The process according to claim 1, wherein both hydrogenation stages are carried out at pressures of from 2 to 100 bar.

Claim 10 (Previously Presented): The process according to claim 1, wherein the catalyst hourly space velocity of the first hydrogenation stage is in the range from 0.02 to 2 kg of reactant/l of catalyst hour.

Claim 11 (Previously Presented): The process according to claim 1, wherein the catalyst hourly space velocity of the second hydrogenation stage is in the range from 0.02 to 2 kg of reactant/l of catalyst • hour.

Claim 12 (Previously Presented): The process according to claim 1, wherein the molar hydrogen/reactant ratio in the first hydrogenation stage is at values of from 20 to 650.

Claim 13 (Previously Presented): The process according to claim 1, wherein the molar hydrogen/GBL ratio in the second hydrogenation stage is at values of from 20 to 1000.

Claim 14 (Previously Presented): The process according to claim 1, wherein the reactor used in the first hydrogenation stage is a fixed bed reactor, a shaft reactor, a fluidized bed reactor or a reactor having internal heat removal.

Claim 15 (Previously Presented): The process according to claim 1, wherein the reactor used in the second hydrogenation stage is a fixed bed reactor, a tube bundle reactor, a fluidized bed reactor or a reactor having internal heat removal.

Claim 16 (Previously Presented): The process according to claim 1, wherein the volume of the individual shaped body in the first hydrogenation stage is < 10 mm³.

Claim 17 (Previously Presented): The process according to claim 1, wherein the CuO is less than 80% by weight, and is more than 20% by weight, of an oxide having acidic sites present.

Claim 18 (Previously Presented): The process according to claim 1, wherein the oxide having acidic sites is Al₂O₃.

Claim 19 (Previously Presented): The process according to claim 1, wherein the catalyst of the first hydrogenation stage is one or more metals or a compound thereof, from the group consisting of the elements of groups 1 to 14 of the Periodic Table of the Elements.

Claim 20 (Previously Presented): The process according to claim 1, wherein the catalyst is in the form of an extrudate.

Claim 21 (Previously Presented): The process according to claim 1, wherein the catalyst of the second hydrogenation stage, in addition to CuO, oxides selected from the group of ZnO/Al₂O₃ mixtures, delta-, theta-, alpha- and eta-modifications of Al₂O₃, and mixtures which comprise Al₂O₃ and at least one component from the group of SiO₂, TiO₂, ZrO₂ on the one hand and from the group of ZnO, MgO, CaO, SrO and BaO on the other, or which contain at least one component from the group of SiO₂, TiO₂, ZrO₂ on the one hand and from the group of ZnO, MgO, CaO, SrO and BaO on the other.

Claim 22 (Previously Presented): The process according to claim 1, wherein the catalyst of the second hydrogenation stage comprises oxides selected from ZnO, ZnO/Al₂O₃ mixtures in a weight ratio of from 100:1 to 1:2 and mixtures of SiO₂ with MgO, CaO and/or ZnO in a weight ratio of from 200:1 to 1:1.

Claim 23 (Previously Presented): The catalyst according to claim 1, which is activated by reduction, before or after installation into the reactor and before use in the hydrogenation reaction.